A PHYSICAL INVESTIGATION OF THE PERFORMANCE OF BRASS MUSICAL WIND INSTRUMENTS

BY

DANIEL WILLIAM MARTIN

A.B., Georgetown College, 1937

M.S., University of Illinois, 1939

AN ABSTRACT OF A THESIS

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY IN PHYSICS IN THE GRADUATE SCHOOL OF THE UNIVERSITY OF ILLINOIS, 1941

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A PHYSICAL INVESTIGATION OF THE PERFORMANCE OF BRASS MUSICAL WIND INSTRUMENTS

Measurements of physical characteristics of brass wind instruments were made by the use of various electrical and acoustical devices. The instruments were considered as consisting of the player's lips which act as the source of vibration, and the horn which is an acoustical system with resonant transmission and radiation properties. Spectrum analyses of the acoustic output for different notes were measured in a free field, with special consideration given to the relative position of the microphone and horn. Directional radiation characteristics were obtained by driving the horn electroacoustically and plotting the sound pressure field for each driving frequency. A method was developed, using directional radiation characteristics for conversion from single point pressure measurement to total power output for a horn with a bell of given shape. The method was applied in expressing the spectrum analysis of an instrument as the power output at each harmonic frequency. Steady state response curves were measured for the horns, to determine the effect of transmission properties on spectrum analysis. Sound pressure in the mouthpiece was analyzed by means of a probe tube-microphone combination. Photographs of the player's lips in vibration were taken to provide information for a theory of the process of tone production at the mouthpiece.

VITA

Daniel William Martin was born at Georgetown, Kentucky, November 18, 1918, son of Dean W. Martin, then professor of Physics at Georgetown College. He was graduated from Harbor Springs High School, Harbor Springs, Michigan, in 1934. He received the A. B. degree from Georgetown College in 1937. From 1937 to 1941 he was an Assistant in the Physics Department of the University of Illinois. During this period he carried on graduate work, receiving the M. S. degree in 1939.

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